Report of
NATIONAL RANGE WORKSHOP
1958

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

REPORT OF THE
NATIONAL RANGE WORKSHOP
Phoenix, Arizona, January 21-24, 1958

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UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Washington 25, D. C.
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To Service personnel:

The attached report is a summary of the proceedings of the National Range Workshop held at Phoenix, Arizona, January 21-24, 1958, and expresses the conclusions and recommendations on which the entire group reached agreement. Until these recommendations are incorporated in Service instructions or otherwise approved by the Administrator, they do not constitute Service policy.

Sufficient copies of the report are being furnished to State Offices in the range States to supply one each to the Soil Conservationist on the State Program Staff, the State Soil Scientist, Area Conservationists, and appropriate field range conservationists and soil scientists. Other copies are being furnished directly to Washington-Field Range Conservationists and Soil Correlators.

F. G. Renner
Head Range Conservationist

Attachment

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PURPOSES AND GENERAL PLANS FOR THE 1958 NATIONAL RANGE WORKSHOP

By
F. G. Renner
Head Range Conservationist

In welcoming you to the fourth consecutive National Range Workshop, I need not remind you that this is a different kind of a meeting than those we have held in the past. Unlike other years, this is a joint meeting of the two groups of Service technicians most concerned with the collection of the information we need in conservation planning on range lands - the soil scientists and range conservationists.

In the past we have had many problems. The land capability system is one of these. Range men have found the "hazards under cultivation" aspect of little value in applying the system to land in continuous cover where range use and management are tied far more closely to condition of the vegetation than they are to characteristics of the soil.

Another problem that has given us considerable trouble is the relationship between "soils" and conservation practices. On cropland we are actually able to manipulate the soil through tillage or a number of other soil management practices. Here there is an obvious relationship between the different kinds of soils and the conservation practices they need. No such close relationship exists on range land where our primary concern is with manipulation of the vegetation. The need for such practices as fencing, proper use, deferred grazing, water development, or even seeding and water spreading may have little to do with soil differences.

Many of our problems have tended to disappear as we have become more familiar with the terms, procedures, objectives, and principles of each

other's work and the primary purpose of this meeting is to reach a better mutual understanding of the approaches our two groups take to common problems.

We are not here to develop Service policy, or to draft an Administrator's memorandum. Nor are we "talking for the record." Each one of you is here because of the varied and particular experience you have had with most of the subjects we plan to discuss. We want the benefit of that experience, expressed without reservations and to the point.

In order to get the most out of our meeting, a number of you were asked some weeks ago to prepare "working papers" on specific subjects. These papers will be presented and the ideas and concepts in them critically examined and fully discussed. The only limit on the discussion will be that exercised by the Chairman when he concludes the subject, or the participants, are exhausted. As we proceed, these papers will be changed or amplified as necessary until they reflect the opinions of the group and, as revised, will constitute the report on our workshop. This procedure is designed to give direction to our own discussions as well as to make our conclusions available to others. Since it is planned to have the final papers reflect the opinions and conclusions of the entire group, no author's names will be shown. A record of the name of the individual preparing the original draft may be obtained from the agenda, however, which will be included as an appendix to the report.

OBJECTIVES OF SOIL SURVEYS ON RANGELANDS
(As a part of the National Soil Survey)

The basic objectives of soil surveys are the same for all kinds of land. The intensity, however, varies and is related to the possible influence of the soil survey on the decisions made about the use and management of land for any purpose. Intensity, as used here, reflects the number of mapping units, the number of delineations, and the effort applied to identify the soils and to locate soil boundaries accurately.

The basic objective of soil surveys is to help people learn more about soils, their behavior, and responses to management for any purpose.

Soil classification is independent of interpretations for use and management of land, but it is related to and influenced by such interpretations now recognized or anticipated. In plant classification it is not necessary to demonstrate that two kinds of plants must have different use possibilities before they can be recognized or classified as different kinds of plants.

The design of soil mapping units, also, is independent of interpretations, but like soil classification, it too is related to and influenced by interpretations. In fact, the influence and relationship is greater.

Failure in the past to recognize this principle, that soil classification and the design of soil mapping units are independent of interpretations although related to and influenced by them, has created problems that we are still having to deal with today.

There are many principles that have come to be accepted by and are now a part of the National Cooperative Soil Survey. They are the result of many years experience and many discussions and arguments. Additional principles will now be presented.

All soil characteristics are considered in soil classification but the relevance or importance attached to any one varies, depending upon the other characteristics of the soil. This principle is perhaps the most difficult one for soil scientists to grasp. It is expressed in the second paragraph of page 7 of the Soil Survey Manual as follows:

> "Many thousands of unique kinds of soil exist in the world--as many as there are significant combinations of the genetic factors. The characteristics of each can be learned through observation and research in the field and in the laboratory. The history of a soil and its potentialities are contained in these characteristics, considered collectively. The influence on soil behavior of any one characteristic or of a variation in any one, depends upon the others in the combination. (Probably more faulty predictions about soils result from failures to recognize this principle than from any other error.) A general system of soil classification comprehends all observable relevant characteristics."

Perhaps, this principle can be understood better if we consider two possible alternative approaches. One would be to select a few soil characteristics and ignore all the rest. This one would result in a failure to recognize many relevant soils. Another approach would be to consider all characteristics and to apply the same relevance to each wherever it occurs. The result of this approach would be, not thousands of recognized soils, but billions of them. Actually, however, the result would be essentially no classification. Soil classification is as much concerned with soil similarities as with soil differences.

Interpretations play an important part in the application of the above principle. They influence the relevance attached to each soil characteristic in the many combinations of other characteristics. Interpretation, of course, must be of the entire soil as an entity--the unique combination of characteristics that it is--or serious errors are probable.

The needs of all users for information of soils and their location are considered in designing any survey, but the needs of the principal users are given major consideration. It is impossible to design a survey that will provide all users with the kind of a survey most useful to them. Information that is relevant to one user may not be relevant to another user, and if excessive, may be a serious detriment to him. Therefore, any survey is a compromise.

A survey for any user can have too little or too much information. Starting from zero, each additional increment of information--additional mapping units and more delineations--represents an increase in usefulness. As the total increases, however, each increment of information becomes less useful because its relevance is less and also because the difficulty to comprehend and use the whole increases. Eventually a point is reached where the additional information actually decreases the usefulness of the survey. And there is still more information in the field.

We must not assume, however, that mapping units added later in the course of the survey are of little relevance. They may be the most relevant ones but just haven't been encountered earlier.

A soil survey of an experimental field in southern Iowa was made on a scale of 1 inch equal to 100 feet--52.8 inches per mile. About 100 man days were used in making this survey of only 320 acres. Even with this intensity, much information remained in the field. Relative to this survey, most surveys for irrigation would be of low intensity and regular surveys in humid regions would be of very low intensity. Thus, we must learn to realize that we always leave information in the field and the question that we always answer--rightly or wrongly--is how much should be shown.

Three questions which should be answered, if possible, about each mapping unit before it is added to the identification legend, are as follows:

1. Can it be defined and mapped accurately and consistently?
2. How relevant is it to soil classification and to use and management of the land for any purpose?
3. How much does it add to the cost of the survey?

These questions need to be considered simultaneously because the answer to any one may influence the answer to the others. Sometimes one cannot answer them without some trial mapping. Nevertheless, the soil scientists should always keep them in mind.

The intensity and scale of published surveys vary between counties, and they may vary within counties.

OBJECTIVES OF THE SOIL SURVEY ON RANGE LANDS FOR RANCH PLANNING

To deal effectively with this subject it was considered necessary, first, to agree on certain broader aspects of the soil survey in relation to the Departmental objective in its conservation activities. Six statements, on various phases believed basic, were agreed upon by the group. Quoted material is from the Soil Survey Manual, USDA, 1951.

1. "... it is generally far cheaper to make a basic soil survey from which many simple groupings ... may be derived by interpretation, than to concentrate on one ... objective at a time in separate surveys. Nor can there be an all-purpose grouping."

2. Even with an accurate, highly detailed survey more data may be needed for drainage, irrigation, land clearing, intensive forestry, etc. "To ... get all these data, along with a detailed survey, on the chance that they might be needed some day, would increase the cost beyond reason."

3. The soil survey is concerned primarily with four use classes, namely, cropland, rangeland, woodland, and wildlife land. The Soil Survey Manual recognizes three use classes as primary, namely, cropping, grazing, and forestry; but mentions contributions to management plans for recreation, mining, public services, wildlife preservation, protection of water supply or other land, and others.

4. A soil surveyor properly recognizes all soil subdivisions needed for the most intensive land use that is both feasible and clearly in prospect. Since there are many kinds of users of the soil survey, there properly are many kinds of interpretive groupings. Groupings of soil survey units are likely to be changed more frequently than soil survey maps.

5. Soil survey units must be grouped in different ways to plan adequately for production primarily of cultivated crops and tame pasture, range forage, woodland products, and wildlife.

6. When soils are grouped for use in planning grasslands, forest lands, and wildlife lands, the interpretive groupings should be given a distinctive terminology; for example, "range sites", "forest sites", and "wildlife sites" or "wildlife land types." This terminology should be used in lieu of "land capability groups."

The objectives of the soil survey on range lands for ranch planning are those for a single land use for a single purpose. Conservation plans for ranches reflect the desires of ranchers; and can reflect refinements in soil survey data only to the degree that technicians are able to make practical and acceptable interpretations of them.

Among objectives of the soil survey, under these circumstances, there is one that must be attained because it has universal application in all ranch plans with conservation features. That one is: To provide the foundation for range site classification, which, in turn, permits a classification of the condition of the ranch resources.

Other objectives of the soil survey on ranges for ranch planning are desirable if attainable with reasonable additional cost. They are applicable only in certain cases, and often may best be met as needs arise. Such occasional objectives may include:

I. Providing data on arability; with and without irrigation and drainage.

II. Providing data for application of specific practices or treatments. Examples of these include:

A. Range site modifications by waterspreading, drainage, manipulation of water table, and application of soil amendments.

B. Surface modifications to hasten secondary succession, such as pitting and contour furrowing.

C. Stockwater developments, fence construction, and construction of ranch roads and trails.

D. Indicate feasibility of using specific machines for brush control, range seeding, or application of chemicals.

SOIL MANAGEMENT. Soil management is "the preparation, manipulation, and treatment of soils for the production of plants, including crops, grasses, and trees." (Soil, 1957 Yearbook of Agr.)

On most range lands, soil management is accomplished almost solely by manipulation of the grazing animals. On specific areas of range land, however, examples of soil management practices that may have value include contour furrowing, pitting, water spreading, chaining, plowing, seeding, fertilization, and mechanical treatment to control undesirable plants.

SOIL TAXONOMIC AND MAPPING UNITS.

1. Soil taxonomic units. Soil taxonomy refers to the system of grouping soils according to natural similarities. Soil taxonomic units, therefore, are the divisions or groups of this natural system. Each soil taxonomic unit, or natural soil group, consists of a single kind of soil but commonly embraces a very large number of individual soils. According to the Soil Survey Manual "A taxonomic unit is a creation in the mind of man to facilitate his thought about objects in numbers so great that he cannot comprehend them individually... Each unit should be thought of as consisting of (1) a central core or nucleus--a single modal profile representing the most usual condition of each property of all soils in the class, and (2) many other closely related profiles that vary from this central nucleus within precisely defined limits."

Examples of soil taxonomic units in the 1938 Yearbook of Agriculture soil classification are the following:

Zonal soils (order, category VI)
Light-colored soils of arid regions (suborder, Category V)
Desert soils, Chestnut soils, Podzols (great soil groups, Category IV)
Mohave family (family, category III)
Weld (series, category II)
Weld loam (soil type, category I)

The comparability to categories and groups of the plant taxonomic system will be apparent: phylum - class - subclass - family - genus - species.

2. The soil phase. A soil phase is a "subdivision of a soil type or other taxonomic unit having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil." In other words, soil phase is not a category in the natural classification system. We may have phases of great soil groups, of families, of series and of soil types. They are useful primarily for naming soil mapping units and for arranging soils in interpretive tables. For example, the soil type Quincy loamy fine sand covers a range in slope gradient from 3% to 15% in one area; it may be eroded severely, moderately, slightly, or not at all. From the point of view of soil taxonomy, the entire range in slope gradient and in degree of erosion is included within the soil type definition. From the point of view of use and management of these soils, though, it is important to subdivide the soil type according to slope classes and erosion classes. This will permit making rather detailed and accurate statements about each soil phase. Thus we may have the following phases of Quincy loamy fine sand:

Quincy loamy fine sand, uneroded, 3-8% slopes
Quincy loamy fine sand, eroded, 3-8% slopes
Quincy loamy fine sand, uneroded, 8-15% slopes
Quincy loamy fine sand, eroded, 8-15% slopes
Quincy loamy fine sand, severely eroded, 8-15% slopes
etc.

3. Soil mapping units. Soil mapping units are defined segments or combinations of segments of taxonomic units that are delineated on soil maps. A soil mapping unit may have the same name as a taxonomic unit. "A soil mapping unit that bears the name of a taxonomic unit consists of this defined taxonomic unit and sometimes also small inclusions of other soils that must be included because of the limitations imposed by the scale of mapping and the number of points that can be examined. In other words, any single soil name stands for a specially defined unit in the taxonomic system of classification; but that same name, applied to a mapping unit, stands for that defined taxonomic unit plus a small proportion of other units, up to about 15 percent, that cannot be excluded in practical cartography." (Soil Survey Manual).

The most refined mapping units are phases of soil types. This kind of mapping unit is common in detailed soil surveys but uncommon in generalized or reconnaissance surveys.

"The soil association is a group of defined and named taxonomic soil units, regularly geographically associated in a defined proportional pattern." (Soil Survey Manual). The pattern of individual soil areas is coarse, and the individual soils could be delineated separately at the map scale used if it were desirable to do so. Soil associations are common mapping units on generalized soil maps (see soil association map of the United States accompanying the 1938 Yearbook of Agriculture.)

"The soil complex is a mapping unit, used on detailed soil surveys, which consists of two or more recognized taxonomic units. These may be similar or contrasting but occur together in a more or less regular pattern, and are so intimately associated geographically that they cannot be separated by boundaries at the scale used." (Soil Survey Manual). Of course, complexes may also be used in less detailed surveys, but they are not very common units in any but detailed surveys.

"Two or more recognized taxonomic units that are not regularly associated geographically may also be mapped as a single unit--an undifferentiated group--if the differences between them are too small to justify separate recognition for the objective of the soil survey," (Soil Survey Manual). For example, the loam and silt loam types of the Gem series may behave alike so far as production of range forage plants is concerned; in a soil survey of range lands, these two soil types might be combined as a single unit, though they never occurred side by side in the field. Undifferentiated groups are common mapping units in generalized and reconnaissance soil surveys.

Examples and explanations of some soil mapping units are given below:

(a) Phase of soil type: Mohave loam, gentling sloping.
This unit consists mainly (85% or more) of that portion of the Mohave loam soil type (taxonomic unit) that occurs on gentle slopes (2 to 5% gradient). The remainder of the unit (15% or less) consists of small, unmappable inclusions of Gila silt loam, gently sloping, Anthony loam, gently sloping, and other soils.

(b) Soil association: Hugo-Josephine loams, hilly.
This unit consists of the taxonomic units Hugo loam, hilly (about 60% of area) and Josephine loam, hilly (about 30% of area), with about 10% of rock outcrop. These soils occur in a regular, definite geographic pattern that is related to topography, drainage and runoff. The Hugo loam occurs on the steeper, convex slopes; Josephine loam occurs on the less steep, concave slopes and receives some runoff from Hugo soils.

(c) Soil complex: Elfrida-Gothard loams, nearly level.
This mapping unit consists of a fine, complex pattern of two principal taxonomic units and one minor one. The principal components are the salty Elfrida loam (about 75%) and the alkaline Gothard loam (about 20%). Spots of severely eroded Gothard loam make up the remaining 5%.

(d) Undifferentiated soil group: Uvada and Antelope Springs soils, undifferentiated, nearly level.
This mapping unit consists dominantly of Uvada loam (70%) and Antelope Springs silt loam, moderately to strongly saline and strongly alkali affected (15%), both nearly level. Included soils are Crestline fine sandy loam, Heist fine sandy loam, Uvada silt loam and Beryl very fine sandy loam, strongly saline-alkali. These two soils may or may not occur side by side.

4. Miscellaneous land types. Some non-soil areas must be shown on the soil survey maps. These are called miscellaneous land types. In practical mapping work, their recognition and definition depend partly upon the detail required for the objective of the survey. They are named primarily in terms of land form and secondarily in terms of material. Examples are Badland, Mine dumps, Dune land, Lava flows, Rock outcrop, Tidal flats, and Swamp.

RANGE SITE AS AN ENTITY, AS AN INTERPRETATION, OR BOTH. Range sites are unique entities that may be defined according to their natural characteristics. The definitions may be according to vegetative characteristics, or environmental characteristics, or both. Range site maps may also be derived by interpretation of soil maps.

The following definition of range site is given in Administrator's Memorandum SCS-89, dated July 11, 1955:

> "Range sites are kinds of range land that differ from each other in their ability to produce a significantly different kind or amount of climax or original vegetation. A significant difference means one large enough to require different grazing use or management to maintain or improve the resource."

It is apparent from the above that a range site may be identified by its climax or original vegetation. From the ecological point of view, then, the range site is a unique entity. The assumption is made that under a given set of environmental conditions (a given combination of soil, topographic, climatic and natural biotic factors) a specific plant association will gradually develop and finally reach a state of dynamic equilibrium. In this equilibrium condition, the site has a characteristic productivity for the plants in its association. The assumption of equilibrium with the environment is essential to consistent identification and delineation of range sites, because the vegetation may be ephemeral, affected markedly by fire, flood, cultivation, or excessive grazing.

It is also apparent that the range site may be defined in terms of the physical environment that determines it. That is, the range site may be specified by its soils, climate, topography, slope aspect, etc., without saying anything at all about its vegetation past or present. Of course, the identification and establishment of significant range sites requires understanding of the relationships between plant associations and the physical environment, derived from observation of nature or by experimentation. Once these relationships are understood, though, it is possible to identify range sites without reference to the plants themselves.

Soil scientists and range conservationists both hold to the assumption that soils and plants "grow up together," that is, that the soil and its vegetative cover go through a sequence of gradual changes that ultimately result in a state of dynamic equilibrium. Stated in somewhat different words, at equilibrium the soil represents a kind of integration of all the environmental forces. The analogy with the "climax" or "natural" vegetation is apparent.

A common misconception among non-soil scientists is that "soil" refers strictly to the soil profile at a point. This misconception is exemplified in references to "soil, slope and erosion," "soil and topographic features" and the like. It is important to realize that soils are three-dimensional bodies on the surface of the earth; that is, they are segments of the landscape. As such, each soil has a characteristic <u>shape</u>, involving depth and topographic features, including orientation or aspect of slope as well as slope gradient; each soil has a characteristic <u>soil climate</u> (temperature, humidity, etc.); each soil has a characteristic microorganic population;

and so on. Taking this concept of soil, it is simple to relate unique, defined plant associations to defined soil taxonomic and mapping units. For example, a bluebunch wheatgrass-Idaho fescue-Sandbergs bluegrass association characterizes Gem very stony loam and very stony clay loam, shallow, south exposure, 20-40% slopes, 12 to 14 inch rainfall phases. Thus, it is possible to interpret soil maps in terms of range sites, and to group soil mapping units into range sites. To do so requires knowledge of the relationships between the soil mapping units and natural or climax vegetation. It also requires, of course, that the design and conduct of the survey take proper account of these relationships. If the survey is designed and carried out so as to delineate all of the kinds of soil that are significant to range forage production, then the range sites can be derived directly from the soil map, regardless of the present condition of the range.

RANGE SITE. Reference has been made in the preceding paper to the definition of a range site as given in Administrator's Memo. SCS-89. Examination of official documents prepared at the field level reveals that many of them contain other, or substantially modified, definitions of a range site. Statements concerned with mapping procedures and interpretations of surveys are not uncommonly substituted for the accepted definition in soil survey documents. An example of such a substitution is "Range sites are an interpretation of the soil survey." This statement fails to define range sites and can be misleading. (The group agreed that this kind of a statement should be avoided). In actuality, a range site map can only be derived from a soil survey if the soil mapping units and their boundaries are properly defined.

It is recommended that all official Service documents dealing with definitions of range site use the definition contained in Administrator's Memorandum SCS-89. The alternative is an eventual multiplicity of definitions expressing variable concepts, none of which could be specifically identified as the accepted Service standard. This recommendation does not preclude the use of additional explanatory material, including aspects of mapping and interpretation procedures when needed for further clarification.

CONCEPTS OF RANGE SITE REQUIRING FURTHER CLARIFICATION.

1. There is need to recognize the range site as the sum product of the total physical environment rather than the product of a single or several isolated environmental factors. Not one of the single factors of climate, soil, topography, or vegetation serves individually to create or describe a range site. Within a localized segment of climate, an individual environmental factor may, however, serve to characterize or aid in identifying range site.

It is recommended that official Service documents and publications dealing with the description and nature of range sites, emphasize the fact that such sites are the sum product of the total physical environment.

2. Additional criteria and data are needed to augment empirical judgments currently used to determine the validity of existing or proposed range sites. Involved are specific decisions as to when differences in kind or amount of plant cover are significant enough to warrant site differentiation. Presumed practical limitations in grazing management and use tend toward a wider latitude while proposed mapping units and legends for some soil surveys tend toward a narrower latitude in variability allowed within a range site. Either viewpoint can be carried to extremes. Additional quantitative data, supplemented by the experience of conservation ranchers in carrying out sound management plans, will ultimately aid in the solution of this problem. In the interim it must be recognized that individual soil mapping units, as currently established in some soil survey legends, frequently are not synonymous with individual range sites. (See Section on Range Site Mapping Units.)

3. The majority of range sites in current use are readily differentiated from each other due to major variations in physiography or potential composition. Such differentiation is more difficult in areas where relatively uniform topography, soil, and climate result in gradual changes in environment. The lack of abrupt changes in composition and herbage yield in such continuums necessitates some arbitrary decisions as to when site changes should be recognized. Currently some tangible change in climate, such as variations in annual precipitation at a given limit of latitude, is commonly used to differentiate site under these conditions. If site differentiation is based upon a fixed interval of annual precipitation change, such as 5 inches, it should be borne

in mind that the effect of this change varies for humid as compared to semi-arid or arid climate. In humid climates, variations of 5 inches in precipitation may result in relatively minor changes in potential plant cover. In contrast, variations of one to two inches may assume major significance in arid climates. With specific reference to soil surveys, the foregoing situation creates a problem inasmuch as soil mapping units may frequently overlap the arbitrary range site boundaries established to differentiate site under these conditions.

4. Under existing criteria, site differentiation is based upon significant variations in kind or amount of plant cover. In some few cases steep slopes or escarpments, may support a similar potential kind or amount of plant cover but require variations in management which should be provided for in the conservation plan.

5. Further attention needs to be given to the classification and nomenclature of land supporting native grassland vegetation which is not or should not be used for grazing due to permanent physical limitations. Of primary concern are those areas of obviously excessive slope, aridity, and permanent inaccessibility.

RANGE SITE MAPPING UNITS are defined as the areas of rangeland enclosed by boundaries which serve to delineate range sites on a map of a specific grazing unit or pasture.

USE OF RANGE SITE MAPPING UNITS. Range sites occur on the land in various patterns and combinations. Depending on the specific area involved, they may occur as (1) a relatively large acreage of a single range site; (2) a dominate range site characterized by inclusions of acreages of other range sites; or (3) an intimate mixture of several range sites so positioned on the ground that separate delineation of the individual sites is neither feasible nor practical.

The intensity of mapping range sites is governed principally by the feasible and practical limitations of rangeland use and management. Therefore, in actual field practice, the boundaries drawn to map range sites may enclose a single range site, but not infrequently they enclose an area of a dominant site containing smaller inclusions of other sites or an intimate mixture of several sites. Such boundaries, in effect, delineate range site mapping units designed to map a specific area of rangeland at an intensity compatible with practical limitations in management and use. The individual sites included in such mapping units retain their identity. This is essential inasmuch as the specific pattern of plant succession governing range condition is distinctive for each site. No single criterion for judging range condition can validly be prepared for an area mapped as a mixture of several range sites. It, therefore, is essential that the components of mapping units designed to map range sites for a given locality be clearly identified.

Such mapping units should be identified and described in the descriptive legends of soil surveys on rangelands. For ready reference, these mapping unit descriptions may also be added as a separate section to technical range site descriptions. It should be clearly understood, however, that such mapping instructions are not an integral part of the range site description.

RANGE SITE NAMES. Administrator's Memorandum No. 89 establishes Service policy for naming range sites. Among other criteria it states that the purpose of naming range sites is to aid landowners to recognize and remember the significant kinds of range land in their locality. It further states that site names should be (1) brief; and (2) based on readily recognized permanent physical features. Plant names reflecting changing range condition should not be used in site names. Where local names for particular sites are already established and in common use, their use should be continued unless they are misleading.

CURRENT TRENDS IN NAMING RANGE SITES. Prior to and since the establishment of the above policy, site names in various localities have been progressively revised. Currently, most site names are based on one or more permanent physical features of the environment. Most names are based either upon (1) a combination of a physiographic feature and a soil characteristic, such as sandy plains and clay hills; (2) a soil characteristic, such as silty site and clayey site; or (3) a physiographic feature, such as breaks and badlands. Exceptions to this general rule are such names as hardlands, savannah, mountain meadow and scabland.

POSSIBLE FUTURE TRENDS. Considerable progress is being made in adjusting site names in accordance with established Service policy. There is a problem concerning the correlation of range site names across state boundaries. This leads to some speculation as to whether standardized national range site names should be established and used. While such a procedure undoubtedly would have some merit from a technical and scientific standpoint, this advantage must be carefully weighed against the stated purpose of aiding landowners to recognize and remember the significant kinds of rangeland in their locality. Locally established names that have come into common usage by landowners through a long period of years are not easily disrupted from the minds of such landowners.

It is recommended that the current trend toward the adjustment of site names based on criteria established by Service policy be continued and expedited Administrative and technical personnel should attempt to reconcile conflicting site names for identical kinds of rangeland at state boundaries.

SOIL FACTORS OF DIRECT CONCERN IN RANGE CONSERVATION

Vegetation is a product of two things; heredity and environment. We here are concerned with environment. The soil is nearly one-half of the range-plant's environment. That is, the range plant exposes about one-half its surface area in the soil. On ranges the root and shoot are affected by direct, indirect, and remote site factors as follows:

SITE FACTORS

Direct	Indirect	Remote
1. Soil water content	Soil structural arrangement	Altitude
2. Soil solutes & contact exchangeable ions	Precipitation	Slope
3. Soil air	Wind	Exposure
4. Soil temperature	Pressure	Surface
5. Air temperature		
6. Humidity		
7. Light		

The first four Direct Factors are resident in the soil and relate directly to plant growth. The attaching of much significance to such remote factors as altitude, slope, and exposure can cause muddy thinking when trying to relate vegetal responses to land factors. It is believed that if differences in altitude, slope, and exposure cannot be pointed out in soil profile differences, then their effect on natural vegetation is generally too small or too uncertain to use in applying range condition classification with ranchers.

We do use the indirect factors of soil structural arrangement and precipitation to indicate the four direct site factors resident in soils. This

is an almost necessary expediency in field work, but points to the need for laboratories to relate soil composition to the four direct site factors; under specified conditions of climate.

We know that soils can differ in their effects upon plant growth only insofar as they differ in direct site factors 1 - 4. We also know that soils of quite different origin, morphology, slope, and appearance may not differ measurably in net effect of interaction between direct site factors. If they do not, we have little or no reason to recognize another range site, though men trained in soils classification might recognize different soils within one range site.

Yet, range sites may be expected to conform more closely with pedological units than do capability units for cultivated introduced crops because range sites are based on units of natural vegetation. Such units of natural vegetation are a product of climate, parent rock, time and soil, just as natural soil units are a product of climate, parent rock, time, and natural vegetation. Hence, there should be no conflict between pedologist and range conservationist concerning basic criteria for subdividing the continuum of soil and vegetation.

Range soil, like range vegetation, normally occurs in gradients from one kind to another. Units recognized were not created as such but are based on our logic. Nevertheless, classification is necessary if we are to record and utilize experience. Different intended uses may require different degrees of subdivision. A soil scientist properly recognizes all subdivisions needed under the most intensive land use foreseeable. Where there are soils subject to many land uses, and with many kinds of users of soils information, there

properly are many interpretive groupings of the units recognized by Soil scientists. Where only one land use is feasible, only one grouping should be used by users of soil survey information and, therefore, lines other than these, on soil survey maps may add little or detract from their usefulness. Range sites are a grouping for planning conservation operations with range users on lands suitable and intended for range use.

WORKING RELATIONSHIPS BETWEEN SOIL SCIENTISTS AND RANGE CONSERVATIONISTS ON STANDARD SOIL SURVEYS

Range conservationists and soil scientists can improve the quality and efficiency of at least five phases of soil survey operations on range lands by working together. These phases are the following:

1. Preparation of the soil survey work plan.
2. Selection of mapping units and preparation of the mapping legend.
3. Progress field reviews that deal with problems of survey legends, mapping procedures, and interpretations.
4. Development of interpretations of the survey for assisting in improved management of soils for range.
5. Preparation of certain chapters in the soil survey report.

In addition, there may be situations where the advice of the range conservationist will be helpful in designing field-laboratory investigations to augment the survey.

The soil survey descriptive legend is a critically important document. It provides guidelines or criteria for the classification and mapping of the soils and it constitutes a record of the survey operations. It is a valuable tool for quality control of the survey. Ordinarily, the first draft of the legend is prepared at the time of the initial field review, in the very early stages of the survey. At this time, decisions must be made about the usefulness of various alternative mapping units, about the need for different degrees of cartographic detail, and about the classification of the different kinds of soils encountered. The range conservationist can help to make these decisions wisely by contributing his knowledge and understanding of the significance of proposed mapping units, of the degree of topographic detail that

needs to be shown, of the probable significance of specific combinations of soil characteristics to vegetative growth, and the like. The soil scientist who acts as party leader needs to consider several important objectives of the soil survey, of course, such as its usefulness in predicting soil behavior under cultivation, where that is a reasonable alternative to range use; its value for engineering and watershed planning purposes; and so on. Therefore it commonly happens that some kinds of map detail need to be shown that have little or no significance to the management of the soils for range. But so long as range use is important in the area, the range conservationist can be of great help in selecting and defining mapping units that will satisfy all the ordinary objectives of the survey without resulting in excessive detail. Another reason for joint effort at the very beginning of a survey is this: The range conservationist has important responsibilities in interpretations and reports as the survey progresses and comes to completion; if he and the party leader are to carry out their respective assignments with skill and confidence, there needs to be understanding by both of the design of the survey and the procedures to be used. Since many of the major decisions on procedure are made during the initial review, that is the time for the two specialists to begin their collaboration.

Progress field reviews will be conducted from time to time during the course of the survey. Sometimes these reviews are carried out simply to assure supervisors that quality and consistency of mapping are being maintained. More often they are done to assist the field soil scientists on problems of mapping, classification, nomenclature and interpretation. Whenever the progress reviews deal with design of mapping units or with proposed changes in the mapping legend, the range conservationist should be a member of the review party. Just

as in the early, legend-forming stage of the survey, his knowledge of vegetation and of soil-vegetation relationships can help to make the proper decisions about alternative mapping units, cartographic detail, and mapping techniques.

The soil scientist is interested in all kinds of interpretations of the soil map, and there are many: Land-capability groupings; groupings according to range site and woodland site index; groupings according to adaptability to irrigation; interpretations for watershed planning and for engineering purposes; and a host of others. The soil scientist is not an expert in all of these interpretations, though, so he looks to specialists in other fields for assistance in working out interpretations and interpretive groupings as they are needed. His contribution to mutual efforts is likely to be his detailed knowledge of the different kinds of soils and of their physical behavior under different conditions. The range conservationist contributes his detailed knowledge of soil-plant relationships; of the behavior of plants and associations of plants under different conditions of use and management; and of the significance of these things to range management. Working together, the two specialists can develop better interpretations than either could devise alone.

When the soil survey is completed, the party leader prepares a report for publication. That is, he has responsibility for planning and assembling a report manuscript, although he need not write all of it himself. As in developing interpretations, he requests the assistance of other specialists in some parts of the task. Each report contains a chapter on vegetation and its relationships with the soils of the area. This chapter may well be a joint contribution of the soil scientist and the range conservationist, the range conservationist writing the first draft and then the two specialists reviewing

and revising it together. In areas where there is much range land, the survey report will have a chapter on range management. The range conservationist should write this chapter, with only general review by the soil scientist to assure consistence with other parts of the report.

It needs to be recognized, however, that in many areas, the Service is not prepared to carry out these responsibilities and will not be in a position to do so until experienced range conservationists are made available for this purpose.

1. Plan for the chapter on range management during the initial review of the soil survey legend or at least very early in the survey. This will allow the maximum amount of time to collect technical data and forage yields and to improve range management guides and range site classification, etc.

2. Assign responsibility for writing the range management section of the soil survey report early in the survey. The Range Conservationist should take leadership in preparing the range management information.

3. Develop a general outline to follow in writing the range management section.

The following summary statements resulted from the discussion of this topic:

1. It is obvious that we still do not mutually fully understand concepts and terminology. A common understanding of these is essential to the further development of procedures.

2. We apparently agree on the principles incorporated in the proposal for the development of effective working relationships between soil scientists and range conservationists but such efforts in many instances will be hampered by inadequate staffing to comprehensively do this job.

3. The discussions indicate considerable progress in the joint effort to coordinate soil surveys and range site surveys. However, it is apparent that State by State, this progress follows diverse paths and represents no uniform approach on a national basis. There are some instances where a single survey made in accordance with existing policy and procedures is meeting both objectives.

4. There was recognition of the fact that the primary function of range conservationists is to expedite the preparation and application of ranch conservation plans.

ACTION NECESSARY TO ASSURE CORRELATION BETWEEN RANGE SITES AND SOIL MAPPING UNITS IN THE CONVERSION OF CONSERVATION SURVEYS TO STANDARD SURVEYS

This question presented us a real challenge in Oklahoma because of our large acreage of conservation surveys. It seemed to us that it would be desirable to evaluate and use all available information in preparing standard soil surveys.

Soil conservation surveys have been made in all counties that do not have a published standard soil survey. Standard soil surveys have been completed in ten counties. Several of the published standard soil survey reports do not contain range site interpretative information. The 1958 annual state plan for soil surveys will include range site correlation for all soil mapping units in Woods, Noble, Cleveland. Okfuskee and Harmon Counties.

The Area Conservationist concerned will provide the leadership to accomplish this interpretative work. Soil Scientists, Range Conservationists and Work Unit Conservationists will assist the Area Conservationist with this activity.

Standard soil surveys are in progress in 32 counties. Our past experiences in preparing soil surveys and range site surveys indicated to us that we should be more efficient in coordinating the work of the Range Conservationist and the Soil Scientist. For the most part, the "range site surveys" that were being made by the Range Conservationist indicated only that information needed for conservation ranch planning. This was adequate for immediate needs in conservation work but did not meet the needs of all potential users of a standard soil survey. The same thing can be said about many of the "soil conservation surveys" that were being prepared by the Soil Scientist.

The following is a quote from the Conference Report of State and Territorial Conservationists, Asilomar, California, September 2-6, 1957, on Expediting Soil Surveys for Conservation Farming and Application through Operations Management:

> "The committee feels there are opportunities to bring more of our range surveys under our standard soil survey program. We recommend that where range surveys delineate range sites on the basis of soil types or complexes or undifferentiated soil units and meet the needs for ranch and watershed planning, they be considered to meet the requirements for standard soil surveys and be reported and handled as such."

The "standard soil survey" should show essential information for all of the practical usage to be made of the survey. Administrative memoranda set forth this policy. Teamwork among the Soil Scientist and the Range Conservationist is essential. Development of a soil survey legend should be a joint responsibility of the Soil Scientist, Range Conservationist, Experiment Station representative, Work Unit Conservationist, Forester, and other active users of the soil survey.

I would like to call your attention to several statements in the initial field review of the Kay County, Oklahoma soil survey legend:

> "The initial field review was made by Fred Dries, Beryl Baggett and Raymond L. Marshall, Soil Scientists; R. J. Chance, Area Conservationist; Olen Rowlett and George Rule, Work Unit Conservationists,and Clarence Kingery and Harland Dietz, Range Conservationists."

> "Detailed surveys made prior to 1943 in the Arkansas-Kay Soil Conservation District should be transferred in pencil to new photographs by Cartographic. These surveys will be revised and inked in accordance with the standard survey legend."

There seems to be ample evidence that in areas where the Soil Scientists, Range Conservationists, Soil Conservationists and Engineers are working closely together, we have higher quality work in the production, interpretation

and use of soil surveys. This kind of teamwork should help insure that no relevant soil separations are omitted. Also, this enables the Soil Scientists to become familiar with the alternative uses and treatments of soils, and thus helps them to decide what is relevant detail and what is not. Unnecessary detail, therefore, is left off maps and their usefulness is thereby enhanced.

One of the first actions that should be taken is to conduct a field workshop so that all concerned will have a complete understanding of all information in administrative memoranda that outlines the Service's objectives on this activity.

After the field workshop has been held the Range Conservationist and the State Soil Scientist should implement Administrator's Memoranda 47, 88 and 89 with State memoranda, outlining the objectives and technical standards for the State. Excellent examples are Utah State Memorandum No. 17, Oklahoma State Conservationist's Memorandum OK-27, and Oklahoma Range Memoranda OK-1 and OK-2.

The Range Conservationists and the Soil Scientists in Oklahoma have used the following procedure which we feel has resolved many questions or differences of opinion where they should be resolved--in the field during the preparation of the initial soil survey legend for a survey area:

1. Soil Scientists, Range Conservationists, and Woodland Conservationists concerned, along with Work Unit Conservationists and Area Conservationists working in the county, spend enough time in the field to evaluate the natural vegetation and soils relationship. In a typical county this usually requires two to three days.

It is important that, prior to field work in developing the initial standard soil survey legend, the group review and discuss the present range sites

recognized in the county and the soil conservation survey mapping units included in these sites. If local technicians have done some preliminary work, such as selecting relict or near climax conditions and soil type locations for the range sites being used, it greatly facilitates field work. At this meeting a brief review of existing instructions and procedures is usually desirable. The need for uniformity in range site names between counties can be stressed.

Planned field work should be spent primarily on sites and soils where there are particular questions, with relatively little time being spent on those sites that all are in agreement on. It is generally desirable though for the group to look at all range sites and related soils.

The indoor session should not take more than two hours. If more time is required, there probably was not enough preliminary work done. Little can be accomplished by long indoor sessions. We usually emphasize during these sessions that the decisions on sites are tentative. If we think there is a possibility that we have a new range site, we set it up. The work unit is generally not expected to revise its local range site and condition class guides until we are satisfied with any revisions that are made.

2. Careful notes are kept during the field work. These notes include the site name, soil symbol, soil name, significance of the soil in relation to kinds or amounts of vegetation, and notes concerning kinds of vegetation, forage yields, adaptation for tame pasture, etc. During field work the usual procedure at a stop is (1) identify and describe the soils and discuss their significant characteristics as they influence vegetation, possible land use, etc., and (2) discuss the natural vegetation that characterizes the site, production potential, etc.

3. At the close of the field work the notes are reviewed with the group.

4. The Range Conservationist responsible for correlating sites writes up the notes and sends them to those concerned. After field work is completed, there is sometimes need to review certain problems which may develop that will require a follow-up visit on the part of the responsible Range Conservationist and the State Soil Scientist.

5. When all concerned are reasonably satisfied with the range sites set up for a county, the Work Unit Conservationist, with assistance of the Range Conservationist, revises his range condition class guide. This step often involves some further change in range sites and the local Soil Scientist usually participates in the revision of local range condition class guides.

Soil Surveys in Extensive Grassland Areas

In Oklahoma we recognize a need for more range forage yield information. We are proceeding as rapidly as personnel time will permit to obtain clipping information for each range site. Where more than one soil is included in a site, we are also checking these yields by each soil whenever possible. This year we have obtained clipping yields for counties across the entire north side of the State. Continued yield studies should give us better guides in our correlation work. It should also be very helpful in writing the county soil survey report.

It has been helpful in Oklahoma to have one Range Conservationist designated to correlate range sites between counties throughout the State. This provides for uniformity in site names and in interpretation of procedures. It makes for the best coordination of work with the State Soil Scientist.

The designated Range Conservationist and the State Soil Scientist should maintain a master listing of mapping units (soil names included where known) and range site names. This will assist in maintaining uniformity in designating range site names in new survey areas and additions to current soil survey legends and in recognizing the most useful mapping units for the standard soil survey.

Summary and Conclusions

1. Conduct a field workshop so that all concerned can have a complete understanding of the major objectives in administrative memoranda. The Administrator's memoranda should be implemented with State memoranda, outlining objectives and technical standards for the State.

2. Evaluate all soil surveys in your State (both published and unpublished) and determine their technical quality according to present-day concepts for a standard soil survey.

3. If the county or survey area contains native grasslands, the evaluation should be made jointly by a Soil Scientist and a Range Conservationist.

4. All published standard soil survey reports that do not contain range management information should be evaluated and the mapping units interpreted into range sites. If the published maps are technically adequate, they should provide the range site information for conservation ranch planning.

5. The Soil Scientist and the Range Conservationist should jointly develop the standard soil survey legend in areas containing native grassland.

6. The standard soil survey should show essential information for all of the practical usage to be made of the land.

7. There are opportunities for the Range Conservationist to prepare surveys on rangeland that can be classified and reported as standard soil surveys. This situation should be fully explored in each State.

8. The Range Conservationist and the State Soil Scientist should maintain a list of range site names and soil mapping units used in the State. This will assist in securing uniformity in assigning range site names to new survey areas.

COLLECTION OF FORAGE YIELD DATA

The problem of collecting reliable forage yield data has received considerable attention at previous National Range Workshops.

The San Jose Workshop developed Administrator's Memorandum 89 which stated Service policies regarding the kind of yield data to be collected, and how it is to be used in assisting ranchers to plan and apply ranch conservation plans.

The Denver Workshop developed a standard outline and example for guidance in developing Technical Range Site Descriptions. Yield data for such site descriptions was requested to be indicated in terms of total herbage produced in pounds per acre on each site in climax condition during favorable and less favorable years.

The Great Falls Workshop gave this subject further consideration and developed "Recommended Procedures for the Determination of Herbage Yield."

Apparently total herbage is not considered by all of us to represent a practical expression of yields for each range site and each condition class. Proof of this lack of agreement can be found in the various kinds of yield information used in Technicians' Guides to Range Sites and Condition Classes and in Range Management Sections of Soil Survey Reports.

Before this group enters into a discussion of the Great Falls National Range Workshop recommended procedures, it is suggested that we examine the statements regarding forage yields that are found in Administrator's Memoranda 89 and 47, and Soil Survey Memorandum No. 9 regarding the kind of yield data to collect, how it should be shown and used, and on what units of land it should be based. (The following paragraphs are quoted from the above cited Memoranda to aid in this review).

Administrator's Memorandum No. 89. (Page 5, 4th Paragraph) -- "Technicians' Guides to range sites and condition classes should contain a narrative site description and such data on the composition, forage yield, kinds of soil, potential improvement, and estimated stocking rates as essential."

Administrator's Memorandum No. 47. (Page 12, 5th Paragraph) -- "As the work progresses in interpretation of each mapping unit should be made which includes basically the alternative systems of management together with yield estimates and the effect of alternative systems of management on long-time productivity. These materials are basic for capability groupings and other groupings of the soils (such as range sites). The descriptive legends should reach this stage as soon as any important use is made of the maps by anyone other than trained soil scientists."

Administrator's Memorandum No. 47. (Page 17, Beginning with the 2nd Paragraph) -- Soil Survey Interpretations and Reports: "Basic to interpretation of soils is the synthesis of available research and experience so that for each kind of soil we know the adapted crops and probable yields under physically defined systems of management and the effects of these systems on long time productivity."

Administrator's Memorandum No. 47. (Page 17, Last Paragraph) -- "In making predictions about the behavior of specific soils under defined use and management, we are particularly concerned with:

> "The yield and quality of crops, grasses, and trees from specific soils under defined management, and the effects of such use on the soil ..."

Soil Survey Memorandum No. 9. (Page 6, 2nd Paragraph) --"The basis for sound soil survey interpretation work is an organized body of specific information related to specific kinds of soil in the nationwide system of soil classification. Yield estimates of adapted crops (including forage and trees) under defined systems of management, research data from laboratories and experimental fields, and the recorded experiences of professional workers and others concerned with the soil, need to be assembled by named soil types and phases. This orderly information forms a basis for making predictions about the behavior of individual soils and for grouping soils into capability units and in other ways for various purposes."

Soil Survey Memorandum No. 9. (Page 7, 2nd Paragraph, 2nd Sentence) -- "Where available, soil research data and other important interpretive soil information should be recorded as they relate to forestry, range, hydrology, and soil mechanics as well as to soil and water conservation practices with field and horticultural crops. It is important to record significant laboratory data as well as yields and other field data."

Soil Survey Memorandum No. 9. (Page 7, 4th Paragraph) -- "Less formal interpretative soil information such as yield estimates and others, although valuable, should be recorded separately from actual research data."

Soil Survey Memorandum No. 9. (Page 9, 3rd Paragraph) -- "After synthesis of the results of field and laboratory observations and other data bearing on the responses of soils to management, the soil scientist and other appropriate technicians and specialists make predictions about each kind of soil in the area, including specifically:

1. Yield and quality of crops, grasses, and trees under defined systems of management and the effect of such systems on the soil.

Summary of Statements in Administrator's and Division Memoranda Regarding the Need for and Use of Forage Yield Data

Administrator's Memorandum No. 89 requires forage yields to be obtained for each range site and for each condition class.

Administrator's Unnumbered Memorandum of May 17, 1956 calls for herbage yields to be shown in technical range site descriptions. This describes the site in climax condition and expresses herbage yields (based on plot clippings and weights) in pounds per acre for favorable and less favorable years.

Administrator's Memorandum No. 47 requires forage yield data to be obtained for each mapping unit (Page 12, 5th Paragraph), and for each kind of soil under physically defined systems of management (Page 17, 2nd and Last Paragraphs).

Soil Survey Memorandum No. 9 requests yields to be obtained for:

1. Specific kinds of soils (Page 6, 2nd Paragraph).

2. Soil mapping units (Page 8, Last Paragraph).

It appears that the above-quoted statements are conflicting to the extent that considerable confusion and disagreement is arising in the field between range conservationists and soil scientists. It is, therefore, recommended that the memoranda quoted be re-examined and the statements be brought into agreement either by revision or by appropriate explanatory statements.

It is important to note that technical range site descriptions emphasize the fact that climax vegetation varies 100% or more in herbage production between favorable and less favorable years. During prolonged periods of severe drought, there may be no growth of vegetation at all.

Some technicians' Guides to range site and condition classes or Range Condition Guides, however, show recommended or initial stocking rates by sites and condition classes and in some locations pounds of forage per acre, that may be expected during average or normal years. Narrative statements accompany these expressions of yearly forage production to point out the variations in forage yields that result from yearly climatic variations. The need to adjust livestock numbers and amount of grazing use to each year's forage crop to obtain proper range use and maintain or improve range conditions is also emphasized.

In spite of the above precautions, it is the feeling that normal or average year guides to stocking will be interpreted by ranchers and technicians from other agencies as "grazing (or carrying) capacities." This is most apt to occur where recommended, suggested, or initial stocking rates, or pounds of forage per acre are indicated for specific kinds of soils or for each range site and condition class in soil survey reports or in other publications.

The above poses a real problem to SCS technicians who do not believe in set "grazing" (carrying) capacities based on normal or average years, or on 25%, 35% or 50% below average production years. How then can we meet this problem in a practical way?

The following is suggested as one method of meeting the above problem in such a way that our yield information cannot be misinterpreted:

It is recommended that we follow the pattern set up in our Technical Range Site Descriptions and show forage yields for favorable and less favorable years for each range site and each condition class. This should be done on Technicians' Guides to range sites and condition classes and in published soil survey reports. By so doing, the accompanying explanatory statements which

show the need for and how to make yearly adjustments to obtain proper range use, will carry more weight. This will also greatly reduce the possibility of misinterpreting as "grazing capacities" our suggested recommended or initial stocking rates, or pounds of forage per acre.

This should not involve more work on the part of range conservationists. Care would have to be exercised, however, to avoid cluttering our guides and reports with crowded and excessive information. If yields were shown for favorable and less favorable years, we would be meeting the problem "head on", and we could emphasize to SCS technicians and ranchers the need for carefully keeping livestock in balance with the yearly or seasonal feed and forage supplies.

Herbage yields apparently are not acceptable to part of the country and must be converted to terms more directly usable by ranchers and technicians in ranch planning and application work.

This poses a need for developing a practical guide for converting herbage yields into forage yields and ultimately into safe stocking rates, such as, A.U.M's./ Acre or Acres/A.U.M., if desired.

Two methods in use to convert herbage yields into forage yields and suggested stocking rates are described as follows:

1. Species clipped from 9.6 sq. ft. plots are grouped into forage and non-forage groups and weighed in grams. Both green and air-dry weights are obtained. Air-dry weights are usually used to show herbage and forage yields. The sum of the air-dry weights of the two groups multiplied by 10 expresses herbage production in pounds per acre.

One-half the air-dry weight of the group of forage species multiplied by 10 expresses the approximate pounds of forage produced per acre.

2. Species clipped from 9.6 sq. ft. plots are kept separate or placed into groups with similar grazing use factors. The total air-dry weights in grams of all species multiplied by 10 expresses pounds of herbage produced per acre.

Pounds of forage produced per acre are determined by multiplying the gram weights of the individual species or groups by their locally determined grazing use factors and totaled.

The sum of the gram weights of forage produced by individual or groups of species multiplied by 10 expresses the approximate pounds of forage produced per acre.

Conversion of forage yields, expressed in pounds of forage per acre, to stocking rates is being attempted by various agencies through the use of pounds of air-dry forage required per Animal Unit Month.

Examples of A.U.M. air-dry forage requirements in use are:

1. 600 to 670 pounds per A.U.M. is used by some U.S.F S. Range Experiment Stations. (Taken from Morrison's Feeds and Feeding).
2. 900 lbs. is used in some localities by U.S.F.S. administration.
3. 800 lbs. is being used in the Western States by SCS technicians.
4. 750 lbs. is used by Oregon. This amount was obtained from The Union State Experiment Station records.

Pounds of available forage produced per acre, determined by the two methods described, and converted to Animal Unit Months of grazing through any of the above monthly feed requirements, have proven to be dangerous and unreliable guides to proper stocking. There are several problems affecting the reliability of such figures. The major one is the fact that forage yields obtained through plot clipping weights represent a degree of precision in grass (forage) harvesting that is seldom, if ever, attained by grazing animals.

Grazing animals progressively harvest the forage crop over a long period of time during which they trample down considerable forage, leave numerous patches ungrazed, and otherwise waste a considerable portion of the forage crop. A major portion of the forage is also harvested during the dormant season after part of the herbage has been shattered, blown away, leached by the wetting and drying action of rain and sunshine, and used to some extent by rodents and wildlife.

Attempts have been made to compensate for the loss of forage and the lack of uniformity in forage harvesting by grazing animals through a compensating increase in the pounds of forage shown as required per A.U.M. The previously cited conversion figures, do not appear to make adequate allowances for these.

In conclusion, the following recommendations are made for consideration:

1. Bring Administrator's Memoranda No. 89,47, and Soil Survey Memorandum No. 9 into agreement regarding the basis for which yield information is to be obtained.

2. Obtain herbage and forage yield data on each range site and for each range condition through direct estimates supported by plot clipping weights taken at every opportunity as self training and as supporting information. Summary of data collected in this manner over a period of years will show the variations in herbage and forage production caused by climatic variations, by range sites, and condition classes.

3. Show forage yields on our range site and condition guides and in Soil Survey Reports in pounds of available forage per acre in each condition class for both favorable and less favorable years.

4. Develop locally applicable pounds of forage required per A.U.M. under different systems of grazing.

5. Develop appropriate instructions in how to adjust grazing use to meet yearly fluctuations in forage production.

RANGE INFORMATION TO BE INCLUDED IN SOIL SURVEY REPORTS

Information on management of soils for the production of native range forage is being included in many of the soil survey reports now being written or recently completed. In counties where range is now a significant land use or a practical alternative for future use, range management information is a necessary component of the report. In areas where woodland is a primary land use, and where natural forage is an important secondary crop on woodland areas, information on the production and management of natural forage in relation to soils and timber production should also be provided.

Range information now being presented in various soil survey reports is similar in some respects; different in others. To present range information accurately and in balance with the information on other land uses, a guide for use of field personnel who are writing reports is needed.

The following proposed guide for writing range management sections of soil survey reports is the result of studying reports or outlines for reports from Nebraska, Washington, Kansas, Montana, and Oklahoma. In many instances portions of this material have been used verbatim or with slight changes. In addition, the views of several range men presently engaged in assisting with such reports have been most helpful.

The guide is meant to clarify the content and scope of range information to be included. The question of presentation is still open - should range management information be presented in a separate chapter or section, or should the various parts of the range management information be presented with similar kinds of information on the other land uses, more or less throughout the report? The group recommended wide leaway in this respect, depending on the importance of the range resources in the area and other factors.

1. Nature, Extent, Location, and Importance of Range Resources and Their General Condition.

Such information can be presented in a brief paragraph of several concise statements.

Example:

Native range or land used for the production of range forage is confined mainly to the highland section of the county. These lands make up more than three-fourths of the land in the county, and, as a rule are not suitable for cultivation. The highland ranges are hilly and stony, but produce good forage when managed properly. Livestock is the second largest agricultural industry in the county and depends for its existence on the way ranchers manage and take care of their range forage. The highland range country was originally covered with tall grasses and scattered post-oak and blackjack oak trees. Due to overuse, selective grazing, and other influences, the oaks have closed in as the grass stand was thinned out. Much of this land is now producing only one-half the forage it is capable of producing.

In addition to the highland range country, 20 sections or about half of the natural prairie areas of the county are still in native grass. Although these areas are suitable for cultivation and the production of crops, they are being used to produce native hay. Most of the native meadows are still in a high state of productivity.

2. Range Management Principles (Re-write to apply locally)

On rangelands, high forage production, soil, water and plant conservation are obtained primarily by improvement of the native vegetation. This is accomplished by managing the grazing to encourage and increase the best native forage plants.

Leaf development, root growth, flower stalk formation, seed production, forage regrowth, and food storage in the roots are essential stages in grass development and growth. Grazing use must allow for these natural growth sequences if maximum forage yield and peak animal production are to be obtained.

Livestock graze selectively, constantly seeking out the more palatable and nutritious plants. If grazing use is not carefully regulated, the better plants are eventually eliminated. Less desirable or second choice plants can increase. If grazing pressure is continued, even the second choice plants can be thinned out or eliminated and undesirable weeds or invaders take their place.

Research and rancher experience have shown that when about half the yearly volume of grass produced is grazed, damage which occurs to the better plants is minimized and ranges can improve. The forage left on the ground does these things:

1. Serves as a mulch that causes rapid intake and storage of water; the more water stored in the ground, the better the growth of grass for grazing.

2. Allows roots to reach deep moisture; overgrazed grass cannot reach deep moisture because not enough green shoots are left to provide the food needed for good root growth.

3. Protects the soil from wind and water; grass is the best kind of cover for preventing erosion.

4. Allows the better grasses to crowd out weeds, which means that ranges in a low state of productivity will improve.

5. Enables plants to store food for quick and vigorous growth after droughts and in the spring.

6. Holds snow where it falls so that it soaks into the soil when it melts; snow blown into drifts melts where it is of little benefit.

7. Provides a greater feed reserve for the dry spells that otherwise might force sale of livestock at a loss.

Sound range management requires that grazing use be adjusted from season to season in accordance with forage production. Range livestock operations should provide for reserve pastures or other feeds for use during droughts or other periods when forage production is curtailed. This permits moderate use of forage at all times. In addition to forage and feed reserves, it often is desirable to maintain part of the livestock carried in readily salable stock such as stocker steers. Such flexibility allows the rancher to balance his livestock with forage production without sacrificing breeding animals.

3. Range Sites and Condition Classes.

Different kinds of range produce different kinds and amounts of grass. In order to manage rangeland properly, an operator should know the different kinds of land in his holdings and the plants each kind is capable of growing. He is then able to use management which will favor the best forage plants on each kind of land.

Range sites are kinds of range land that differ from each other in their ability to produce a significantly different kind or amount of climax or original vegetation. A significant difference means one large enough to require different grazing use or management to maintain or improve the resource.

Climax vegetation is the combination of plants which grew originally on a given site. The most productive combination of forage plants on range lands is generally the climax type of vegetation.

Range condition is the present state of the vegetation in relation to climax conditions for the site, and is expressed as follows:

Condition Class	Percent of present composition that is climax for this site.
Excellent	76 - 100
Good	51 - 75
Fair	26 - 50
Poor	0 - 25

Ranchers want their rangeland in excellent or good condition because such ranges yield more and have the most cover for soil and water conservation. Determining range sites and range condition classes helps landowners tell how good a range is and how much better it may become under correct use. A range site and condition inventory gives the operator an evaluation of his range resources, and helps him to determine what can be done to maintain or improve conditions on his range.

Some reports include "do it yourself" instructions for interpreting soils into range sites and determining range conditions. Some include lists of decreasing plants with percentages of each that occur in the climax. At least one report examined gave recommended stocking rates for every soil mapping unit as well as the cow days grazing per acre to be expected from each kind of soil area.

Unless the soil survey report is intended to replace farm and ranch conservation plans developed by farmers or ranchers for their own lands with technical assistance from SCS personnel, such instructions and information seem to have little place in the report.

Range site descriptions should be prepared according to the following national standard. Photographs or block diagrams may be useful in clarifying range sites.

STANDARDS FOR A RANGE SITE DESCRIPTION

Location _____
SCD, County.

Date _____

1. RANGE SITE NAME _____ (Rainfall belt where needed to identify the site.)

2. CLIMATE.

   a. Precipitation
      (1) Amount and range.
      (2) Distribution patterns and storm intensity.
      (3) Other significant factors.

   b. Optimum growing season of native plants.
      (1) Other significant factors including temperature variations which may affect the vegetation.

3. TOPOGRAPHY AND ELEVATION.

   a. Including slopes and exposures where significant.

4. SOILS.

   a. Significance of the soils of this site in relation to plant growth, including important differences in such soil characters as texture, depth, permeability, salinity, and erodibility.

   b. List (in narrative or chart form) significant soil series, types, phases, complexes, undifferentiated units, or miscellaneous land forms. List inclusions if significant.

   c. Indicate where complete soil series descriptions can be found.

5. CLIMAX VEGETATION. **

   a. Quantitative description of climax composition, including trees and woody species if present. This may be supplemented if desired by grouping plants into the most common "Decreasers", "Increasers" and "Invaders."

   b. Total forage yields in pounds, air dry, per acre in favorable and less favorable years - based on plot clippings and weights.

   The following additional information may be included where needed:

   c. A short descriptive statement of climax vegetation and land form.
   d. Ground coverage in climax condition, in percent.
   e. Site index, if trees are present.

6. TYPE LOCATION OF THIS SITE.

** On ranges where it is the goal to manage for species other than the climax, the desired vegetation should be described.

4. Grouping of Soil Mapping Units into Range Sites.

Soil mapping units occurring on rangeland will be grouped according to range sites. Such groupings can be presented in table form together with the mapping symbol for each soil, the dominant plants on each site when in excellent condition, and range productivity for each site and condition class.

Column headings within such a table might show:

1. Range site and soils.
2. Map symbol for each soil.
3. Dominant plants on each site when in excellent condition.
4. Range in pounds of air dry usable potential forage per acre site for high and low production years, or relative production expressed by adjectives, or a combination of these methods.

In counties where range sites have been correlated with soil surveys careful consideration must be given to the distinction between range sites as described for the county and the mapping boundaries used to delineate range sites on the ground. Depending on the specific area involved, mapping units may be:

1. a relatively large acreage of a single range site,
2. a dominant range site characterized by inclusions of small acreages of other range sites, or
3. an intimate mixture of several range sites so positioned on the ground that separate delineation of the individual sites is neither feasible nor practical.

In any event, the significant soil series, types, phases, undifferentiated units, or miscellaneous land forms included within each range site will be listed by name.

Where the mapping unit is a complex of range sites, individual sites included retain their identity. This is essential, inasmuch as the specific pattern of plant succession is distinctive for each site. It therefore is necessary that the components of mapping units designed to map range sites for a given locality be clearly identified and described in descriptive legends whether they be soil units or range sites.

Example of table format:

Soil mapping units of Highland County, Arkansas arranged by range sites, plants originally dominant on each site and range site productivity by condition classes.

Range Site and Soils	Map Symbol	Dominant plants when site is in excellent condition	Site productivity in lbs. of usable potential air dry forage per acre.	
SANDSTONE RIDGE				
Muskingham stony, sandy loam	M1	Big bluestem)		
" " loamy sand	M2	Little bluestem)		
" " loam	M3	Indiangrass)	70%	1600 - 2600
Hector stony, sandy loam	H1	Switchgrass)		
" " loamy sand	H2	")		
Boone sandy loam	B1	Brush - 10%		
		Post Oak)) 20% Blackjack oak)		

5. Forage Yield Data by Range Site and Condition Classes, Including Place of Grazing Capacity and Stocking Rate Data.

Productivity of range sites by condition classes can be shown as part of the table shown on item 4. Since forage yield on any range is governed by several variable factors including sites, condition classes, weather conditions, and quality of management, it may differ considerably from year to year. Forage yield information is furnished to show comparative productivity of sites and the advantage of keeping range lands in high condition.

Grazing capacity, which has been defined as the ability of a range unit to support a constant number of animals without inducing deterioration of the soils or forage, has long been one of the "sacred cows" of range management. Succeeding generations of range technicians have been taught that stocking the range on the basis of its "sustained grazing capacity" is the most important means of achieving satisfactory range management, vast sums have been spent on attempts at its determination, and entire systems of public range land administration have been based on the application of such estimates.

No private land operators who have maintained or improved their ranges have followed such a system, and its application on public lands has been accompanied by widespread and severe depletion. These observations are confirmed by our own experience which indicates that, in the face of the wide fluctuations in forage production that characterize all ranges, stocking the range on the basis of its "average" or "sustained grazing capacity" is the one sure way to bring about deterioration.

For these reasons, the Soil Conservation Service has essentially abandoned the concept of grazing capacity. We do not furnish such estimates to land owners in connection with conservation planning, and we believe their

use is both unnecessary and misleading. The Service has followed the practice of furnishing cooperating land owners with information on "suggested initial stocking rates", based on the current condition of their range lands. Every effort is made to point out that such information has only temporary usefulness, however, and it is emphasized that the operator must continually observe the effect of his grazing practices in the light of current growing conditions, and make adjustments in his stocking accordingly.

This approach to the practice of range management has proven eminently successful and is one of the notable contributions of Service technicians in this field. Since we have found grazing capacity estimates unreliable, unnecessary, and misleading in our conservation planning with land owners, it is recommended that such estimates not be included in soil survey reports. Because of their temporary usefulness, suggested "initial stocking rates" should also be omitted from such reports.

6. Range Practices

Range management and development practices should be pointed toward specific sites and of even more importance, toward specific range conditions. This can be done in the discussion of the range practice, or it might be done in a "use and management" statement in connection with the individual range site descriptions.

A. Management practices which improve range vegetation cost little to use and are needed on all range land regardless of what other practices are used.

1. Proper range use means grazing rangelands at an intensity which will maintain adequate residues for soil and water conservation, maintain the most desirable vegetation, or improve the quality of the vegetation where there has been deterioration.

2. Deferred grazing means postponing grazing on a given range to increase the vigor of the forage stand or to permit the desirable plants to produce seed or to increase free from grazing pressure and thus promote natural revegetation. In addition to being an important tool for getting range improvement, deferred grazing is a means of building up a reserve of range forage for later use.

3. Rotation - deferred grazing means a system of grazing where one or more range units are rested at planned intervals throughout the growing season of the desired plants. In each successive year each range unit gets different rest periods than during the previous year. This permits all of the important forage plants to fully develop and produce seed every second, third or fourth year.

B. Range improvement practices make it easier to control livestock on the range and to practice better management.

1. Range seeding is the establishment of perennial or improved reseeding grasses or legumes to prevent soil and water losses and to restore ranges in low condition or lands converted from other uses.

2. Water developments should be located over the entire range if possible, so that livestock do not have to walk too far to get a drink. Good distribution of watering places is of great help in achieving even use of the range. Wells, ponds, developed springs, pipelines, and, in some cases hauling of water are means of furnishing livestock water. The nature of each range will determine which type of water development is the most practical to use.

3. Adequate fences should be constructed to provide for good livestock and range management. This may mean separating different classes of stock, providing for separate units for seasonal use, and in some instances fencing sites separately where their differences are great enough and size of the areas large enough.

4. Trails and roads can increase the accessibility of all parts of a range and also facilitate handling of livestock. Trails are needed in steep, rough sites and cattle walkways are very helpful on wetland sites.

5. Control of undesirable plants through mechanical or chemical means may be needed on some sites to permit improvement in range forage and also to make livestock handling easier.

6. Salting is necessary on many sites to supplement native range forage and progressive salting can be used as a tool for improving grazing distribution and getting more uniform range use.

C. Livestock management aspects which must be considered to achieve high production and conservation of range resources include:

1. Proper kinds of grazing animals to suit the forage, soils and climate of the range area can help in range management. Generally, cattle do best on ranges which are predominantly grass; sheep where forage contains a large amount of broad-leaved plants and browse, and goats on sites which produce mostly browse. Under some conditions, a combination of different kinds of animals may be desirable.

2. A feed and forage program including available range forage, concentrates, hay and/or tame pastures, which will keep livestock in a productive or desirable maintenance condition throughout the year is necessary.

3. A breeding program which provides for the type of livestock fitted to the range, seasonal arrival of calves, lambs, or kids to take advantage of forage when most nutritious, and for continued animal improvement consistent with the type of range and climate should be considered.

4. Culling of non-productive animals from range herds can mean an overall increase in production, and can contribute greatly to range improvement.

REPORTING ACREAGE AND TIME SPENT ON RANGE SITE "SURVEYS", IN PREPARING RANGE SITE DESCRIPTIONS, AND TIME SPENT IN DETERMINING RANGE CONDITION.

As an aid in clarifying current Service procedures, maintaining more appropriate records, and reporting range site and condition determinations, the following recommendations were agreed upon:

1. Range site classifications, whether made in the field, or by interpretation from standard soil surveys, should be considered an integral element of conservation planning and should be reported as "Planning Farms and Ranches", rather than as a type of "Soil Survey." The number of ranches, and the acres on which site determinations have been made should be reported as separate items.

2. Range condition determinations are also an essential part of the planning process and the hours spent on such activities should be included in the time reported on "Basic Conservation Plans." Since range condition may be expected to change, current acreage figures by condition classes have only temporary value, and the accumulative figures no value whatever. Accordingly, there is no necessity for records or a report on the acreage on which range condition determinations have been made. Such an item has not been reported separately in the past, and should not be in the future.

3. Time spent in preparing technical range site descriptions, making forage yield studies, preparing technical guides for determining range condition, or assembling and evaluating other technical

materials useful in ranch planning should be reported as E-1, "Technical Material and Studies", as called for by present procedures.

4. Time spent by range conservationists in assembling and preparing, or assisting in preparing, materials for range sections of soil survey reports, should be reported as D-4 (Soil) "Descriptions and Survey Reports".

5. Time spent in making utilization checks and other follow-up work with ranchers to determine what changes have taken place in the vegetation or in the condition of the range should be reported as B-1, "Servicing cooperators on application."

6. Where range site determinations are made in the field by a qualified technician and the information recorded in such a manner that it meets the standards for a standard soil survey, or where such information is converted to a standard soil survey, the acreage should <u>also</u> be reported as D-1, "Standard Soil Survey". The man-hours shown will be only those required to convert the range classification to the standard soil surveys.

On SCS-195.

A. Add on line 4 of Block A, "Range Site Classification". Report in Column 1 the number of ranches on which such a classification has been made during the reporting period, in Column 4 the acres covered, and in Column 3 the man-hours used. In columns 5 and 6, show the accumulative total for number of ranches and acres, respectively.

B. Block D, line 3, Delete "Range Site and Condition Survey."

C. Where range site classifications are made on ranches prior to the soil survey, but in such a manner that they qualify for the standard soil survey, or are converted to a standard soil survey, the acreage of such classifications shall also be included under D-1, Standard Soil Survey. The hours shown in Column 4 will be only those required to convert or complete the survey so that it qualifies as "standard."

APPENDIX

WORKING AGENDA
RANGE CONSERVATION WORKSHOP
Adams Hotel, Phoenix, Arizona.
January 21-24, 1958.

Tuesday, January 21, 9:00 A.M.

I. Introductions: Purposes and General Plans for the Meeting.
F. G. Renner

*** II. What the SCS Expects from Range Conservationists.
E. H. Graham

III. Objectives of Soil Surveys on Range Lands.
A. R. Aandahl
Objectives of Soil Surveys for Ranch Planning.
E. J. Dyksterhuis

Tuesday P. M.

IV. Clarification of Soils and Range Terminology.
Wm. M. Johnson and Arnold Heerwagen

Wednesday, 8:00 A.M.

V. Land Factors of Direct Concern in Range Conservation.
E. J. Dyksterhuis.

VI. Working Relationships Between Soil Scientists and Range Conservationists in the Development, Completion, and Publication of Standard Soil Surveys.
Wm. M. Johnson and A. R. Aandahl

Wednesday P. M.

VII. Action Necessary to Assure Correlation Between Range Sites and Soil Mapping Units in the Conversion of Conservation Surveys to Standard Soil Surveys.
Louis Derr

VIII. Collection of Forage Yield Data.
Waldo R. Frandsen.

Thursday, 8:00 A.M.

IX. Range Information To Be Included in Soil Survey Reports.
R. E. Williams.

X. Reporting: Time and Acreage on Range Site Surveys; Time Spent in Determining Range Condition, in preparing range site descriptions, etc.
C. A. Rechenthin.

Thursday, P.M.

*** XI. Ranch Planning Under the Great Plains Program.
B. W. Allred

Friday 8:00 A.M.

*** XII. Proposals for a Natural Classification of Range Sites.
E. Wm. Anderson

Friday, P. M.

*** XIII. Review of Week's Discussion, Conclusions, Recommendations.
F. G. Renner, others.

*** Reports of these discussions are not included in the Workshop Report.